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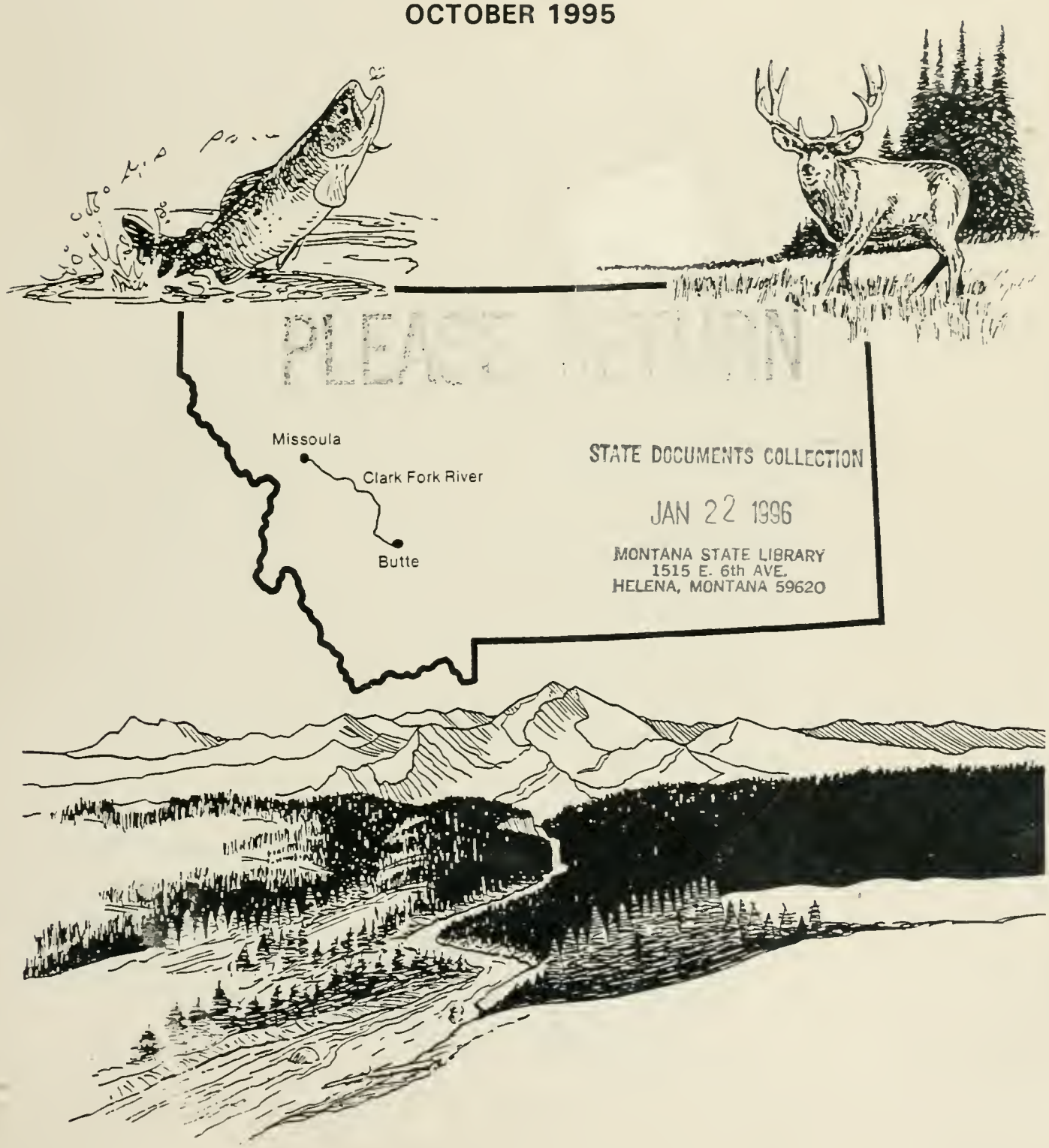
and rebuttal

STATE OF MONTANA
NATURAL RESOURCE DAMAGE PROGRAM

REVISED REPORT AND REBUTTAL:
COMPENSABLE NATURAL RESOURCE DAMAGE DETERMINATION
FOR THE UPPER CLARK FORK RIVER NPL SITES

OCTOBER 1995



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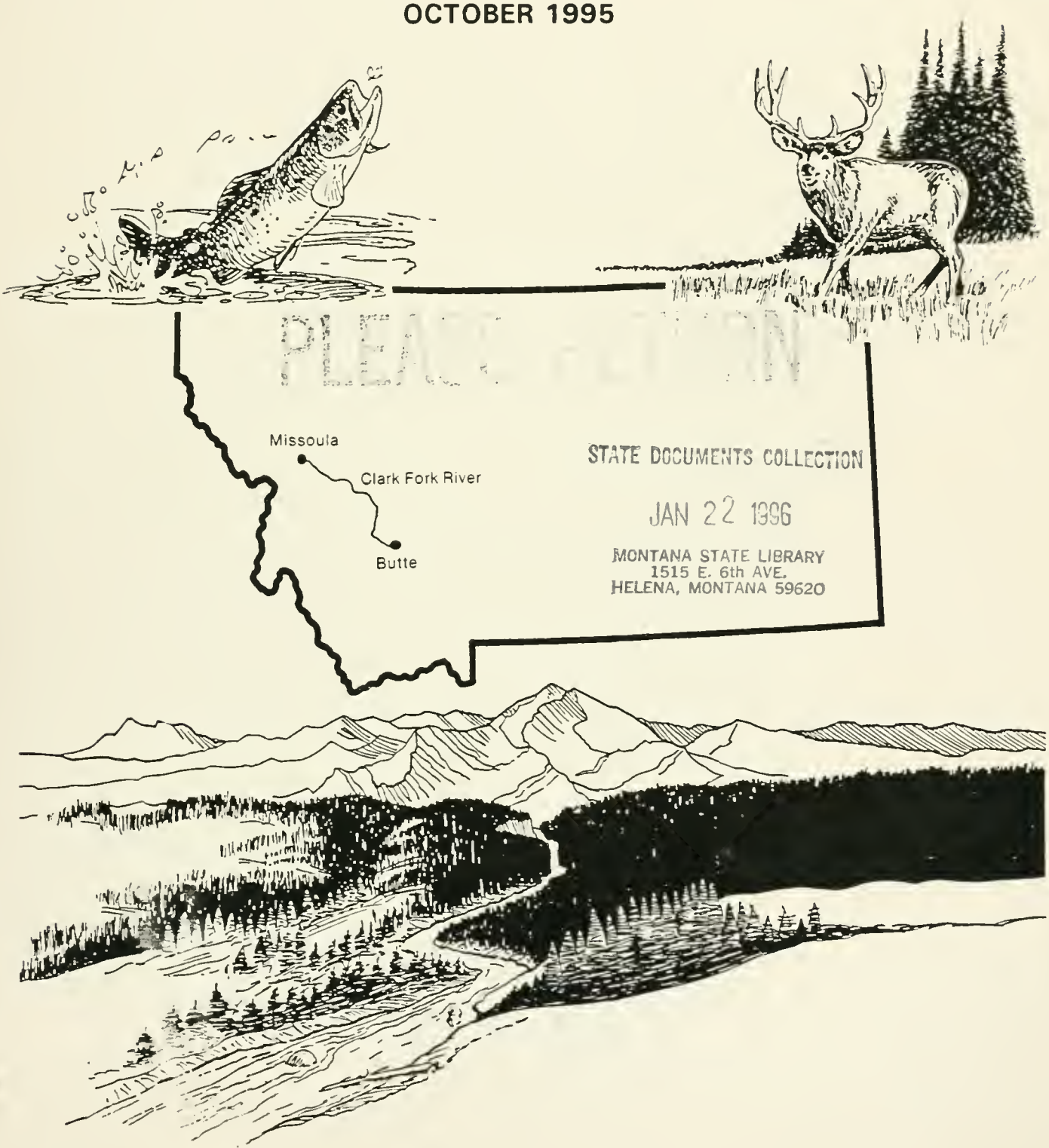

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Revised Report and Rebuttal:

Compensable Natural Resource Damage Determination for the Upper Clark Fork River NPL Sites

Prepared for:

State of Montana Natural Resource Damage
Litigation Program

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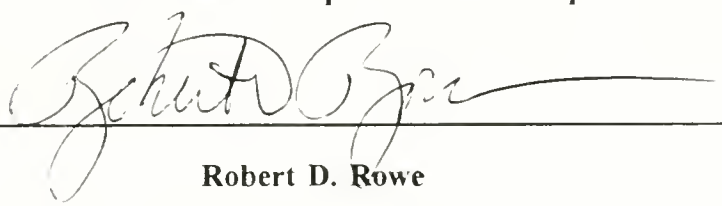
October 18, 1995

REVISED REPORT AND REBUTTAL:

Compensable Natural Resource Damage Determination For The Upper Clark Fork River NPL Sites

Testifying Experts:

Robert D. Rowe on all portions of the report



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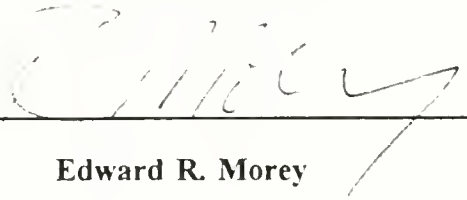
Edward R. Morey on all portions of the report except Contingent Valuation Method issues



Edward R. Morey

William D. Schulze on all portions of the report

William D. Schulze

October 18, 1995

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ACRONYMS

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CV	Contingent Valuation
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NRD	Natural Resource Damage
NRDA	Natural Resource Damage Assessment
NRDP	Natural Resource Damage Program
OMB	Office of Management and Budget
U.S. DOI	United States Department of the Interior
U.S. EPA	United States Environmental Protection Agency
WTA	Willingness to Accept
WTP	Willingness to Pay

CHAPTER 1
INTRODUCTION AND SUMMARY OF RESULTS

This revised Compensable Natural Resource Damage Determination is submitted in rebuttal to ARCO's expert witness reports, which were submitted to the State of Montana in July 1995. The only significant changes in this report are revised computations of damages to reflect revisions in the Assessment of Damages to Anglers and Other Recreators (Morey et al., 1995). This revised report also contains editorial changes and a new Appendix B that specifically responds to comments made by ARCO's expert witness, Dr. Hausman, regarding the previous edition of this report.

1.1 INTRODUCTION

In this report we determine the past, interim, and residual compensable natural resource damages for the Clark Fork National Priorities List (NPL) sites based on the applications of a recreation demand model and the contingent valuation method.

A damage determination is undertaken to "establish the amount of money to be sought in compensation for injury to natural resources resulting from a discharge of oil or release of a hazardous substance" [43 CFR § 11.80 (b)]. Damages include two components:

> The cost of restoration, rehabilitation, replacement, and/or acquisition of the equivalent of the injured natural resources and the services those resources provide. Damages may also include, at the discretion of the authorized official, the compensable value of all or a portion of the services lost to the public for the time period from the discharge or release until the attainment of the restoration, rehabilitation, replacement, and/or acquisition of the equivalent of the resources and their services to baseline. [43 CFR § 11.80 (b)].

Natural resource damage (NRD) restoration costs are those costs necessary to restore natural resources and their services to *baseline conditions* (those conditions that would exist if the release of hazardous substances had not occurred) and are in addition to U.S. Environmental Protection Agency (U.S. EPA) remedies. NRD restoration costs are not addressed in this report but will be addressed in a separate report.

Compensable value includes "the value of lost public uses of the services provided by the injured resources, plus lost nonuse values such as existence and bequest values" [43 CFR § 11.83 (c)(1)]. *Use values* (also called *direct use* values) refer to the values of activities by

individuals and family members that are affected, now and in the future, by natural resource injuries and include impacts to recreation, indirect use, and commercial activities. *Nonuse values* (also called *passive use* values) refer to the values individuals hold to protect or enhance resources not related to their own use and include bequest values to ensure the availability of the resources for use by others now and in the future, and existence values to protect the resource apart from well-identified uses of the resource.[1] Compensable value is added to restoration costs to calculate the total damage claim.

Estimates of compensable value are the estimated damages before, during, and after cleanup activities. In this report we use the term "cleanup activities" to refer to either the U.S. EPA remedy or NRD restoration activities, or a combination of the two that partially or completely return (or restore) injured natural resources and their service flows to baseline conditions. We consider three levels of cleanup activities beyond what has occurred in the past:

- *Complete cleanup* of the sites, or a combination of the U.S. EPA remedy and the NRD restoration that returns natural resources and their service flows to *baseline* conditions.

- *Partial cleanup* of the sites in a manner consistent with or exceeding remedial actions the U.S. EPA will likely require under the Superfund Program, but which will not completely return injured natural resources and their service flows to baseline conditions.

- *No additional cleanup* of the sites. In this case, no remedy or restoration is undertaken now or in the foreseeable future.

Regardless of the cleanup scenario, it will take some time for the injuries to natural resources and their service flows to be eliminated. For this analysis, we conservatively assume that any partial or complete cleanup at the sites will reduce injuries and damages over a 20-year period (a complete return to baseline conditions will likely take much longer), after which time complete cleanup will achieve baseline conditions, and partial cleanup will terminate leaving a constant level of residual injuries and damages.

In this report we group damages into past, interim, and residual damages as defined below (see also Section 2.1):

- *Past damages* are those damages that occurred from the onset of injury up to the present (1994 in this analysis). For this report we consider past damages back to 1981, although injuries and damages have occurred since the late 1800s.

---

[1] These terms are discussed further by the U.S. Department of the Interior (U.S. DOI) (56 *Fed. Reg.* 19759-60). Some authors define the terms slightly differently, but these differences have little substantive effect because damages are the total of all use and nonuse values.

- *Interim damages* are those damages that occur between the time that the U.S. EPA remedy and NRD restoration activities begin (assumed to begin in January 1994) and the time that cleanup activities cease (assumed to be in January 2014).

- *Residual damages* are those damages that occur after the U.S. EPA remedy and the NRD restoration activities are finished, and the benefits from these partial cleanup activities are fully realized. These damages would occur when cleanup activities do not restore natural resources and their service flows to baseline conditions, and these damages continue indefinitely.

In Section 3.5 we address additional damages associated with delaying cleanup, and with delaying the payment of damages, beyond January 1994.

1.2 NATURAL RESOURCE INJURIES AT THE CLARK FORK NPL SITES

Natural resource injuries are described in the injury assessment reports. For this summary, we consider injuries in three groups:

1. aquatic resources and riparian habitat (Lipton et al., 1995a)
2. groundwater resources (Montana NRDP, 1993)
3. upland soils, vegetation, wildlife, and wildlife habitat (Lipton et al., 1995b).

As identified in the injury assessment reports, injuries have existed in the past and are continuing today. In this report we assume that past injuries were at the same level as 1992/1993 injuries, the time period during which injuries were quantified. However, evidence suggests that injuries were even more severe in prior years. Therefore, the damage estimates reported here understate past damages.

1.3 SUMMARY OF RESULTS

Compensable damages are computed in Section 3 and are summarized in Table 1-1. Throughout this report, damages are computed to a present value in January 1994 expressed in 1993 dollars, and using a 7 percent real discount rate, the rate identified in the regulations as the appropriate rate ([43 CFR § 11.84 (e)(2)] and OMB, 1992).

Compensable past damages for 1981 through 1993 are $207 million if paid in 1994 assuming complete cleanup occurs between 1994 and 2014, $221 million assuming partial cleanup, or $257 million assuming no additional cleanup (see Section 3.1). If no additional cleanup is undertaken, the present value in 1994 of residual damages is $183 million. If complete cleanup completely restores natural resources and service flows continuously over 20 years, the present value in 1994 of the interim damages during the cleanup is over $52 million. If

Table 1-1
Summary of Damage Estimates
(millions of $ 1993, present value in 1994)*

Damage Category	Time Period of Damages	Damages
Past Damages	1981-1993	$207-$257**
Interim Plus Residual Damages:		
Complete cleanup	1994-2013	$52
Partial cleanup	1994-ongoing	$88
No additional cleanup	1994-ongoing	$183

* Damages included: Montana resident use and nonuse values for all injured natural resources and natural resource service flows; nonresident use values for fishing and nonfishing aquatic recreation only.
Damages for which no estimates are available: any and all nonresident use damages other than for fishing and nonfishing aquatic recreation; any and all nonresident nonuse values.

** Past nonuse damages vary based on the cleanup scenario (see Section 3.1 and Appendix Section A.1 of this report for details).

partial cleanup partially restores natural resources and service flows continually over 20 years, the present value in 1994 of interim and residual damages is over $88 million.

The time of payment for natural resource damages affects past, interim, and residual damages. For example, if past damages (assuming complete cleanup) go unpaid for 2 additional years, additional interest on past damages would add another $30 million in damages. Damages are also affected by how long cleanup takes. For example, if complete cleanup takes 15 years, then interim damages decrease by about 18 percent. If complete cleanup takes 25 years, interim damages increase by about 15 percent (see Section 3.5).

The reported compensable damages are biased downward for the following reasons:

1. Damages are based on 1992/1993 levels of injuries. Injuries in prior years and decades were greater. Therefore, past damages are understated.

2. Injuries and damages occurred prior to 1981. Therefore, past damages are understated.

3. Interest will continue to accrue the longer past, interim, and residual damages are uncompensated, leading to a larger present value of past damages.

4. Under partial and complete cleanup activities, the partial or complete return of many of the natural resources and their service flows to baseline conditions will take longer than 20 years to be realized. Therefore, the interim and residual damages are understated.

5. For nonresidents, all nonuse values are omitted. In addition, the use damage estimates for nonresidents only include use damages associated with aquatic and riparian recreation. Therefore, past, interim, and residual damages are understated.

1.4 ORGANIZATION OF THIS REPORT

In Section 2.1 we discuss the economic concepts used to estimate natural resource damages. In Section 2.2 we introduce the recreation demand model used to estimate recreation use damages for fishing and nonfishing recreation along the Clark Fork River and Silver Bow Creek, and we introduce the contingent valuation study used to estimate the total of direct use plus nonuse (passive use) values held by Montana residents for all injured natural resources and natural resource service flows.

In Section 3 we apply the results of the recreation demand model and contingent valuation study to estimate past, interim, and residual damages. Detailed calculations are provided in Appendix A. In Appendix B we provide rebuttal to critiques of this report provided in the expert report of July 13, 1995 by Dr. J.A. Hausman.

CHAPTER 2
ECONOMIC CONCEPTS, METHODS, AND STUDIES

In Section 2.1 we briefly introduce the economic concepts used in this assessment. We summarize the recreation valuation and contingent valuation studies and their results in Section 2.2.

2.1 CONCEPTS

2.1.1 Valuation Concepts

Injuries to natural resources affect the service flows that the resources provide to society. Reductions in service flows reduce the well-being of affected individuals through reductions in the ability to use the resource (direct use values), to bequeath the resource to others for use, or to preserve the resource in an unimpaired condition regardless of expected uses (nonuse or passive use values). Damage assessments place dollar values on impacts to well-being that result from natural resource injuries. A "fundamental economic principle is that individual judgments are the appropriate basis of value. That is, when a natural resource is injured, economists use individual values of that resource to determine the worth (value) of the injury" (U.S. DOI, 1987, pp. 1-2). Two monetary measures are routinely used:

- *Willingness to pay (WTP)*: How much an individual would be willing to pay to have no injuries, or to clean up the injuries at the upper Clark Fork sites. WTP is also a measure of damages from having incurred the injuries, or an estimate of what individuals would pay to clean up the injuries, at the upper Clark Fork sites.

- *Willingness to accept (WTA)*: How much compensation an individual would require to be as well off as before the injuries occurred, or have to be paid to accept the injuries.

The WTA measure may be appropriate if the affected individuals have a right to be compensated by polluters. For injuries, WTA measures can be expected to exceed WTP measures, but measurement of WTA is more difficult than for WTP, especially in contingent valuation studies. For this reason, WTP measures are used in Natural Resource Damage Assessments (NRDAs), even though this may bias the damage determination downward. WTP measures are also consistent with choices made everyday in purchasing goods and services and through voting choices that entail costs to support changes in environmental quality and other public goods.

In the next section we review the recreation valuation study and contingent valuation study used to obtain estimates of WTP for cleanup of the injuries to natural resources from releases of hazardous substances in the upper Clark Fork Basin. However, before turning to these studies, three additional issues associated with the valuation of natural resource damages are briefly addressed.

All Past, Present, and Future Damages Must Be Included

The total present value of all use and nonuse values, aggregated across all affected individuals and across all affected years, is what is required for a complete damage assessment. The magnitude of past and interim nonuse damages is influenced by past and current expectations about the timing and extent of restoration. If cleanup activities are, with certainty, to be completed at some point in the future, current and future nonuse damages may be reduced because the natural resource will be available in the future. However, even with cleanup activities, nonuse damages have existed and continue to exist for at least three reasons:

1. If cleanup is not complete, then nonuse damages resulting from residual natural resource injuries continue to occur into perpetuity.

2. Even with a certain and complete cleanup of injured resources at some future date, there are ongoing nonuse damages from the lost bequest and existence values tied to resource injuries between the current year and the time the resource is restored. For example, assuming complete cleanup in 2014, nonuse damages occurred in 1981 (and all subsequent years up to 2014) because the resources would be injured for as many as 33 years.

3. Not until after partial or complete cleanup occurs will there be certainty about what the cleanup will accomplish, e.g., whether and when the natural resources and their service flows will be restored. This ties nonuse damages in the current year to uncertainty about the availability of the resources in the future. For example, until very recently there was little reason to anticipate significant cleanup of the upper Clark Fork Basin, and nonuse damages were incurred because of the uncertainty of the availability of the resources in the future. Even now, with the expectation of U.S. EPA remedy to be imposed, there is still considerable uncertainty about exactly what the cleanup will achieve.

Nonuse values are included in all past, interim, and residual damage determinations. The calculations include nonuse damages tied to residual injuries (item 1 above), and ongoing lost bequest and existence values before completion of cleanup efforts (item 2 above). The procedures to compute the past, interim, and residual nonuse values are presented in Appendix A. To be conservative, the calculations assume that there is certainty that the benefits from cleanup activities will be fully realized in 2014, and we exclude nonuse

damages that result from uncertainty about the future availability of the natural resources and their service flows (item 3 above).

Discounting

In this analysis we apply a 7 percent discount rate as provided for in OMB Circular A-94. If damages are paid in the future (after January 1, 1994), the present value of the estimated damages reported here should be escalated to account for interest.

Values Through Time for Environmental Preservation

The damage determination is based on values held in 1992/1993, when the economics research was conducted. Economists have long held that benefits from the preservation of natural resources may rise over time because the supply of natural resources is fixed, and continued development of these resources (or reduced potential uses because of contamination) may increase their values because of increasing scarcity (Fisher et al., 1972; Smith, 1972). Further, economic studies often show that values increase with real income. Because of the length of time projected for the return of natural resources and their service flows to baseline conditions, this issue is potentially significant. In this analysis we hold values constant through time, which results in a potential downward bias in the damage estimates.

2.1.2 Illustration of Past, Interim, and Residual Damages

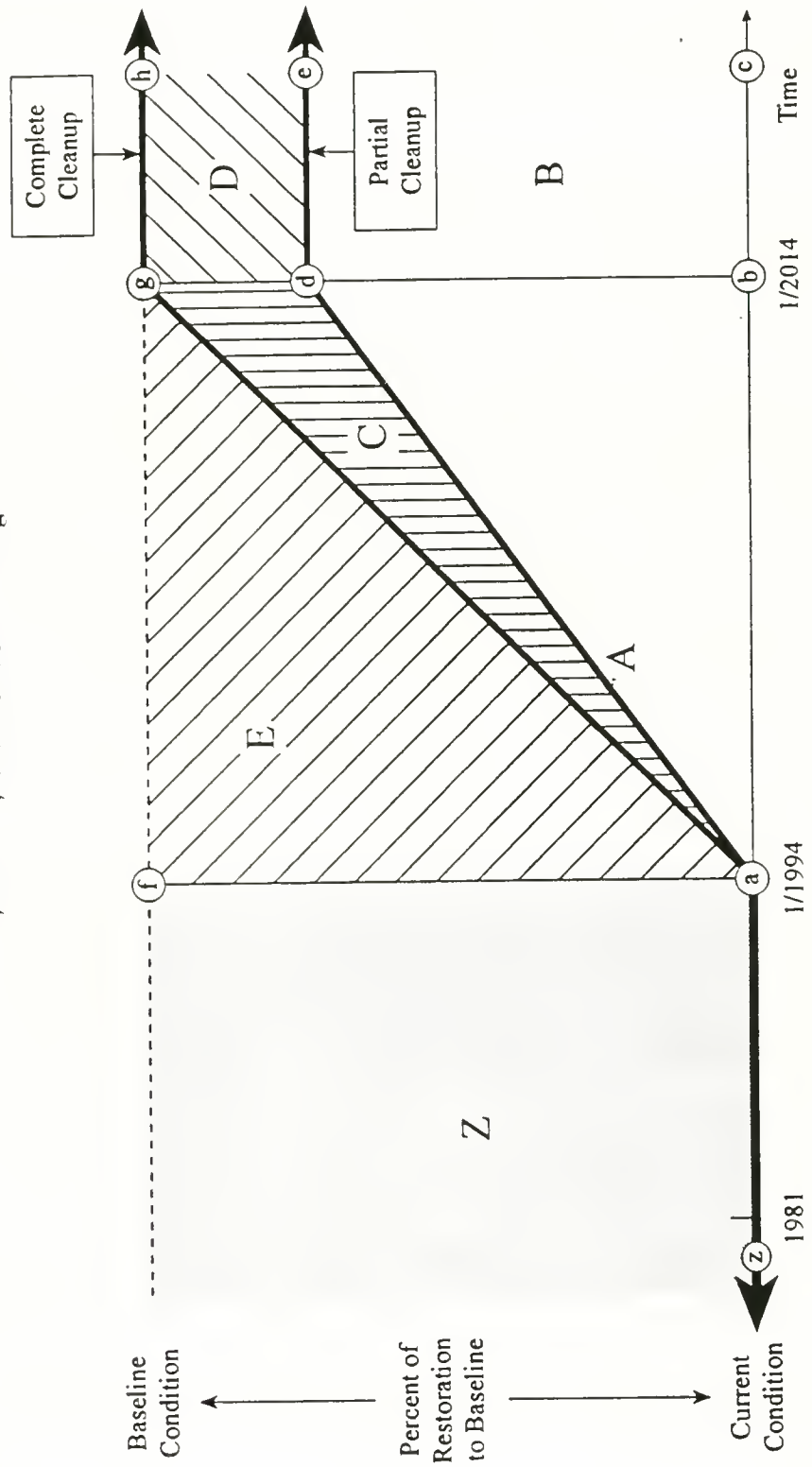
We use Figure 2-1 to illustrate past, interim, and residual damages assuming cleanup activities take place between January 1994 and December 2013. The horizontal axis is time starting before 1981 and continuing past January 2014. The vertical axis measures the restoration of natural resources and their service flows to baseline conditions that is achieved by cleanup activities through time. At the top of the vertical axis, natural resources and service flows are restored to 100 percent of baseline conditions. At the bottom of the vertical axis, injuries remain at 1992/1993 levels.

Future cleanup options are illustrated as follows:

- *Complete cleanup* results in full restoration of resources and service flows following line (agh). In January 2014, all resources and service flows are restored to baseline conditions.

- *Partial cleanup* results in partial restoration of resources and service flows following line (ade). In January 2014, not all resources and service flows are restored to baseline conditions.

Figure 2-1
Past, Interim, and Residual Damages



Z = Past damages.
E = Interim damages during complete cleanup if complete cleanup takes 20 years.
C+E = Interim damages during partial cleanup if partial cleanup continues for 20 years.
D = Continuing residual damages after partial cleanup is finished.

- *No additional cleanup* is illustrated as line (abc).

We assume additional cleanup activities occur in a manner that linearly reduces injuries and damages over a 20-year time period. The partial or complete restoration of natural resources and natural resource service flows, and therefore the reduction in damages, may not exactly follow this pattern. For example, cleanup may proceed somewhat slower in early years, then faster in later years, or vice-versa. The effect on the damage determination of different assumptions about the time period of cleanup is addressed in Section 3.5. Past, interim, and residual damages are represented by various areas in Figure 2-1 as identified below.

Past Damages

Past damages are measured prior to 1994. Here, we measure damages only for 1981 through 1993 assuming injuries in this period are constant at a 1992/1993 level, the period during which injuries were quantified:

Area Z in Figure 2-1 represents the past damages.

Damages Avoided by Additional Cleanup Activities

Additional cleanup activities reduce damages through time:

Areas A + B represents the damages avoided by additional partial cleanup activities.

Areas A + B + C + D represent the damages avoided by additional complete cleanup activities.

Interim and Residual Damages

U.S. EPA remedy and NRD restoration activities will take many years to partially or completely return injured natural resources and their service flows to baseline conditions. During this period, interim damages occur. Once there is a complete return to baseline conditions, there are no residual damages. If cleanup activities do not completely return injured natural resources and their service flows to baseline conditions, there will be a perpetual stream of residual damages. Interim and residual damages are illustrated as follows:

Area E represents interim damages if complete cleanup is achieved.

Areas C + E represent interim damages if partial cleanup is achieved.

Area D represents residual damages if partial cleanup is achieved.

Compensable Damages

Compensable damages include past damages *plus* interim and residual future damages for the level of cleanup that is undertaken: Areas Z + C + D + E for partial cleanup, or Areas Z + E for complete cleanup.

The present values of the damages in Figure 2-1 are computed in Section 3 as multiples of the annual damages derived from the recreation valuation study and from the contingent valuation study.

2.2 THE DAMAGE VALUATION STUDIES

2.2.1 Introduction

Two damage valuation studies were completed: a recreation valuation study and a contingent valuation study. These studies are used to estimate different components of damages as illustrated in Table 2-1. The recreation valuation study is used to estimate use values for fishing and selected nonfishing recreation along the Clark Fork River and Silver Bow Creek for Montana residents and nonresidents. The recreation study does not calculate recreation use values for injuries at sites other than along the Clark Fork River and Silver Bow Creek (e.g., upland areas around Anaconda are not included), surface water use values, or other use values.

The contingent valuation study estimates all use and nonuse values for all natural resource and natural resource service flow impacts at the Clark Fork NPL sites, but only for Montana residents. The contingent valuation study does not provide damage estimates for nonresidents. Both studies estimate the Montana resident recreation damages for injuries along the Clark Fork River and Silver Bow Creek. This overlap is explicitly accounted for in the damage determination in Chapter 3.

For each of the two valuation studies we introduce the study approach and summarize the computed damages. As noted in Section 2.1, the present value of past, interim, and residual damages can be computed as multiples of annual damages based on 1992/1993 levels of injuries. Therefore, the estimates from the individual economic studies are converted to annual damage estimates in the discussions below.

2.2.2 The Recreation Valuation Study

The recreation valuation study estimates the use value damages for fishing and nonfishing recreation along the upper Clark Fork River and Silver Bow Creek (Morey et al., 1995). Below, we separately summarize the fishing and nonfishing recreation damage assessments

Table 2-1
Correspondence between Resource Groups, Service Flows, and Valuation Studies*

Resource Group	Service Flows	Values	Recreation Valuation Study		Contingent Valuation Study	
			Residents	Nonresidents	Residents	Nonresidents
Aquatic resources and riparian habitat	Fishing and nonfishing recreation	Use	X	X	X	
		Nonuse			X	
	All other service flows	Use			X	
		Nonuse			X	
Groundwater	All service flows	Use			X	
		Nonuse			X	
Upland soils, vegetation, wildlife, and wildlife habitat	All service flows	Use			X	
		Nonuse			X	

* "X" indicates the study provides a value for this combination of resource group, service flow, use motive, and population group.

and how the results of these assessments are applied to compute past, interim, and residual damages.

Recreational Fishing Damages

Fish in the impacted area have been and continue to be exposed to hazardous substances. The result is smaller trout stocks than would exist under baseline conditions. For example, Silver Bow Creek, which extends approximately 30 river miles between Butte and Warm Springs Ponds, is unable to support any trout. Average stocks in the 120 miles of the upper Clark Fork River are less than one-fifth of what they would be under baseline conditions.

Reductions in trout stocks reduce expected catch rates for anglers below what they would be under baseline conditions. Reduced catch rates cause damages in at least four ways: (1) anglers continue to take trips to these sites, but they enjoy the trips less because of reduced catch rates; (2) anglers substitute trips away from the injured sites to other sites that have higher costs to visit, have lower catch rates than the impacted sites would have under baseline conditions, or that are otherwise less desirable; (3) anglers forgo fishing trips that they would have desired to take to these sites under baseline conditions; and (4) individuals who would have been anglers in the absence of injuries do not become anglers.

Fishing damages are estimated using a multiple-site recreation demand model, also known as a *travel cost model*. Both the current and proposed regulations recognize using travel cost models as a best available procedure to estimate compensable use value damages [43 CFR § (c)(2)(iv)]. Travel cost models predict how individuals would change their trip-taking behavior in response to changes in site characteristics, and how they value those changes. Multiple-site travel cost models consider how anglers will substitute their fishing trips to other sites, and from fishing to nonfishing. The regulations specifically identify the need to address substitutability of uses (or sites) for injured resource services [43 CFR § 11.84 (f)].

The recreation valuation study included several data collection efforts:

1. *An in-field intercept survey* of 1,951 anglers at 26 different river segments throughout southwestern Montana between May 1, 1992 and August 23, 1992. The 26 study sites included the injured sites (Silver Bow Creek and the upper Clark Fork River between Warm Springs Ponds and Milltown Dam broken down into five segments) and substitute sites. This survey provided catch data and data on visits to the sample sites.

2. *A postcard survey* conducted concurrently with the in-field intercept survey. Postcards were left on cars in the survey area. This survey provided data on fishing and nonfishing activity at the 26 sites. In total, 2,224 postcards were returned and provide data on 6,346 recreational visits to rivers and streams in southwestern Montana.

3. *Follow-up telephone and mail surveys* were conducted during the summer and fall of 1992 with a subset of the anglers in the intercept survey. These surveys were used to collect extensive data on the number of fishing trips and choice of sites, attitudes and opinions about the study sites, and socioeconomic information. In total, 513 anglers participated in these follow-up survey activities.

Overall, the surveys provide data to estimate how changes in catch rates affect both the number of times anglers fish and the selection of fishing sites. The surveys also demonstrate the importance of catch rates to fishing. Anglers state that the number and type of fish they expect to catch at a site are two of the most important determinants of where they go fishing. Trout are overwhelmingly the most sought-after species for cold water fishing at the rivers and streams in southwestern Montana. Furthermore, anglers' perceptions of catch rates at selected sites throughout southwestern Montana are highly correlated with estimated expected catch rates. Therefore, we expect anglers would respond to changes in expected catch rates resulting from cleanup of the Clark Fork River and Silver Bow Creek.

An analysis was conducted to estimate how catch rates at the impacted sites would improve if trout stocks were returned to baseline conditions. The average increase in expected catch rates under baseline conditions along the entire 145 river miles of Silver Bow Creek and the upper Clark Fork River between Butte and Milltown Dam would be about 1.3 additional fish caught during every four hours of fishing, or about an 85 percent increase. With this increase in expected catch rates, these sites would be among the better fishing sites in southwestern Montana.

The recreation demand model was used to estimate how catch rates and travel distances affect how often and where fishing trips are taken. This model was then used to determine what trip patterns would be under baseline conditions. The model estimates that the average Montana resident angler active in river and stream fishing in southwestern Montana would take 0.36 additional trips each year to the impacted sites under baseline conditions. The same figure for nonresident anglers is 0.07 additional trips each year. Most of these additional trips to the impacted sites would be substituted away from other fishing sites.

The mail survey of anglers included contingent behavior questions that asked how the angler would change his or her fishing behavior if catch rates at a segment of the upper Clark Fork River were increased by one, three, and five fish per four hours of fishing. The recreation demand model estimates of increases in fishing trips due to increases in catch rates are consistent with anglers' stated trip responses to increases in catch rates.

The recreation demand model is used to predict the economic value of the improvement in catch rates to baseline conditions. The model computes damages per angler of $6.31 per year for resident anglers and $14.17 per year for active nonresident anglers (in 1992 dollars). To calculate a per-trip measure of damages, one can divide the annual damages for each angler by the number of additional trips per year for each angler to the injured sites if the sites are

returned to baseline conditions. The average dollar-per-additional-trip value is $45.66 (in 1993 dollars).[2] This value is similar to or somewhat less than values reported in the literature for similar sites.

The results are aggregated to the population of Montana resident and nonresident fishing license holders who fish at rivers and streams in southwestern Montana to estimate the total change in site visits per year and annual fishing use damages. These results are summarized in Table 2-2. In total, almost 30,000 additional fishing trips per year are predicted to occur at the impacted sites under baseline conditions, and most of these trips would be taken by Montana residents (an increase of about 70 percent at these sites). Annual fishing damages are estimated to be over $1.4 million (in 1993 dollars).

Nonfishing Recreation Damages

Nonfishing recreation along rivers and streams includes activities such as resting and relaxing, walking or hiking, observing wildlife, camping, boating, hunting, and other activities. Improved fishing at the sites will increase nonfishing recreation by individuals who accompany anglers. Also, just as the release of hazardous substances results in natural resource injuries that affect the fishing experience, so also do many of the same injuries affect the quality and quantity of nonfishing recreation. For example, streamside tailings that affect the fishery also reduce vegetation and the desirability of a site for nonfishing recreation.

Data from the postcard survey described above and data from the literature are used to estimate nonfishing damages, which are summarized in Table 2-2. We estimate that for every 100 additional fishing visits to the impacted sites, there will be 30 additional nonfishing recreation visits, most of which will be by individuals who accompany anglers on fishing trips. We estimate a total of approximately 9,000 additional nonfishing recreation trips to the impacted sites each year if the sites are returned to baseline conditions, or an increase of about 14 percent. Based on the literature, nonfishing recreation trips are valued at about 60 percent of fishing trips. Therefore we apply a unit value of approximately $28 ($46 per affected trip in the fishing study times 0.6) to each additional nonfishing trip. The use of unit values from the literature is a recognized approach to assign damages to recreational impacts [43 CFR § 11.83 (c)(2)(vi)].

Total Recreation Damages

In total, an increase of approximately 38,800 fishing and nonfishing recreation trips to the impacted sites are predicted to occur each year under baseline conditions. The total annual recreation damages in 1992 are $1.67 million (in 1993 dollars).

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[2] 1992 dollars are adjusted to 1993 dollars using an annual inflation rate of 2.99 percent reported by the U.S. Department of Labor, Bureau of Labor Statistics.

Table 2-2
Summary of Recreation Valuation Study Results
($ 1993)

Impact Measure	Population	Fishing Recreation	Nonfishing Recreation*	Total
Additional trips annually to the Clark Fork River and Silver Bow Creek under baseline conditions	Montana residents	25,300	NA	NA
	Nonresidents	4,600	NA	NA
	Total	29,900	9,000	38,800
Damages per affected trip	Montana residents	$18	$11	—
	Nonresidents	$207	$124	—
Total annual use damages	Montana residents	$ 463,000	$ 82,600	$ 545,700
	Nonresidents	$ 953,300	$ 170,100	$1,123,500
	Total	$1,416,400	$ 252,700	$1,669,100

Notes: Includes only recreation damages along the upper Clark Fork River and Silver Bow Creek. Trips rounded to nearest 100. Damages per affected trip rounded to nearest dollar. Total damages rounded to nearest $1,000.
1992 dollars are adjusted to 1993 dollars using an annual inflation rate of 2.99 percent reported by the U.S. Department of Labor, Bureau of Labor Statistics.
Values may not sum exactly because of rounding.

* Nonfishing recreation damages for residents and nonresidents are calculated using the same proportions as for fishing damages. The nonfishing recreation analysis did not originally separate residents from nonresidents.

Source: Morey et al., 1995.

2.2.3 The Contingent Valuation Study

A contingent valuation (CV) method survey was designed and implemented to estimate total compensable damages, including use values and nonuse (passive use) values held by Montana residents, for partial and complete cleanup of natural resource injuries in the upper Clark Fork River Basin (Schulze et al., 1995). The CV study does not estimate compensable damages incurred by nonresidents.

According to the U.S. DOI regulations for natural resource damage assessments, "The contingent valuation methodology includes all techniques that set up hypothetical markets to elicit an individuals's economic valuation of a natural resource" [43 CFR § 11.83 (d)(5)(i)]. CV is recognized as a "best available procedure" for estimating compensable damages.

The CV has undergone Federal Court review (U.S. Court of Appeals, District of Columbia Circuit, 1989). The Court rejected a challenge to the DOI's use of CV in calculating damages.

The court stated, "We find U.S. DOI's promulgation of CV methodology reasonable and consistent with Congressional intent, and therefore worthy of deference," and "We find no cause to overturn U.S. DOI's considered judgment that CV methodology, when properly applied, can be structured so as to eliminate undue upward bias." The same Court decision also ruled that nonuse values are appropriate in damage assessments. Since CV is the only method currently acknowledged by DOI to estimate nonuse values, application of the CV method is required.

More recently, the National Oceanic and Atmospheric Administration (NOAA) commissioned a "Blue Ribbon Panel on Contingent Valuation," which also concluded that CV provides reliable measures of nonuse values as long as a CV study generally follows several recommendations.

> We think it is fair to describe such information *(CV results)* as reliable by the standard that seems to be implicit in similar contexts, like market analysis for new and innovative products and assessment of other damages normally allowed in court proceedings. As in all such cases, the more closely the guidelines *(for conducting a CV study)* are followed, the more reliable the results will be. It is not necessary, however, that every single injunction be completely obeyed; inferences accepted in other contexts are not perfect either (58 *Fed. Reg.* 4601, Jan. 15, 1993). (Text in italics is added for clarity.)

The Clark Fork River CV study is a state-of-the-art application that is consistent with the NOAA panel's guidelines by using reliable approaches for this application. The CV survey provided respondents with information on Superfund NPL sites throughout Montana, detailed information on the natural resource injuries at the upper Clark Fork NPL sites, and information on cleanup options for the upper Clark Fork sites. Through a structured procedure, respondents were then asked for their willingness to pay for programs to completely or partially return the injured natural resources and service flows at the upper Clark Fork NPL sites to baseline conditions.

The CV study was conducted with a random sample of Montana households selected from telephone listings (telephone listings include 83 percent of all households in Montana). The study was completed by 933 individuals, 845 by mail and 88 by telephone. The mail response rate equals 68 percent of all households in the sample, after omitting deceased individuals and bad addresses. The returned surveys have virtually all questions answered.

Most Montana residents are familiar with the Clark Fork NPL sites and feel that cleaning up these sites is important. Most respondents have seen, heard about, or read about the Clark Fork NPL sites: 84 percent for the Anaconda Smelter site, 70 percent for the Silver Bow Creek/Butte Area site, 58 percent for the Milltown Reservoir/Clark Fork River site, and 34 percent for the Montana Pole site. Respondents feel that cleaning up hazardous waste sites

in Montana is very important, and that the upper Clark Fork NPL sites are the most important sites to clean up.

Respondents also feel that cleanup is very important for all three natural resource groups considered: aquatic resources and riparian habitat; groundwater; and upland soils, vegetation, wildlife, and wildlife habitat. Respondents rated bequest and existence value motives as more important than use value motives for cleaning up the sites.

The values measured in the CV study for partial cleanup correspond to Areas A + B in Figure 2-1, but for a 10-year cleanup period rather than the 20 years used in this analysis. The values measured in the CV study for complete cleanup correspond to Areas A + B + C + D in Figure 2-1, again for a 10-year cleanup. The difference between the partial and complete cleanup values correspond to Areas C + D in Figure 2-1 for a 10-year cleanup.

The CV results can be used to measure a total present value, including use and nonuse values, for partial cleanup and complete cleanup of the upper Clark Fork NPL sites. The total present value is divided into values for aquatic resources and riparian habitat; groundwater resources; and upland soil, vegetation, wildlife, and wildlife habitat as listed in Table 2-3. The equivalent annual use and nonuse values are computed in Appendix A and total $10.8 million in use plus nonuse damages each year if no cleanup actions are undertaken.

Table 2-3
Summary of CV Study Results for Montana Residents
(millions of $ 1993, present value in 1993 for a 10-year cleanup period)

Resource Group	Complete Cleanup (Areas A+B+C+D)	Partial Cleanup (Areas A+B)	Difference between Complete and Partial Cleanup (Areas C+D)
Total of all resource groups	$120.2	$88.2	$32.0
Aquatic resources and riparian habitat	$42.7	$31.3	$11.4
Groundwater resources	$40.2	$29.5	$10.7
Upland soils, vegetation, wildlife, and wildlife habitat	$37.4	$27.4	$10.0

Source: Schulze et al., 1995.

The CV study concludes that the results provide a conservative annual damage estimate because nonresidents are omitted, because Montana residents partially reject the responsibility to pay for cleanup (which decreases reported values as compared to the actual values the study attempts to measure), and because of conservative data analysis procedures.

2.2.4 Correspondence between the Recreation Valuation and Contingent Valuation Studies

The recreation valuation study and the contingent valuation study both measure recreation use damages to Montana residents for injuries to aquatic resources and riparian habitat. For complete cleanup, the recreation study results in a 1993 annual use value estimate for *aquatic resource recreation* for residents of $546,000 million. The CV study results in a 1993 annual total use plus nonuse value for *aquatic resources* of $3.84 million (Table A-1), which is several times larger than for the recreation study. The annual aquatic resource value from the CV study is expected to exceed that from the recreation study because the CV study includes other use values and nonuse values that are not measured in the recreation study. If the CV were capturing all of the total value, these results indicate that the values measured in the recreation study are 14 percent of the total values measured in the CV for aquatic resources and riparian habitat injuries. We conclude that because of downward biases in the recreation study, and omission of other water-based use values the total use damages are likely to be understated in the recreation study. In the determination of compensable damages, we use the recreation study results to estimate aquatic resource and riparian habitat recreation use damages. This is because we have recreation use damages for both residents and nonresidents, and because we believe the recreation estimate understates recreation damages.

CHAPTER 3
DETERMINATION OF COMPENSABLE DAMAGES

In this section we provide estimates of past, interim, and residual compensable damages for complete cleanup, partial cleanup, and if no additional cleanup is undertaken. The details of the calculations are provided in Appendix A. Past damages are computed for 1981 through 1993. Interim and residual damages are for cleanups that partially or completely return natural resources and their service flows to baseline conditions in 20 years, as illustrated in Figure 2-1. For aquatic resources and riparian habitat, we split recreation use values measured by the recreation study from other use and nonuse values to specifically address the overlap between the CV and recreation studies. For all resource groups, we split the total CV values into use and nonuse values to reduce nonuse values based on the assumption that additional cleanup will reduce past and interim nonuse damages (see Sections 2.1.1 and A.1). Based on literature values, we estimate that 35 percent of total WTP in the CV is tied to use values and 65 percent to nonuse values (see Appendix B Section B.4.2). These splits are reported in Section A.2.

For each damage category, the reported damage estimates are biased downward because of conservative assumptions or omissions in the underlying recreation and CV total value studies and in the calculations here.

3.1 PAST DAMAGES

Estimates of past damages are summarized in Table 3-1 assuming complete cleanup, Table 3-2 assuming partial cleanup, and Table 3-3 assuming no cleanup. The present value of past recreation use damages is computed as 21.55 (in 1993 dollars, see Appendix Section A.1, Calculation 4) times the annual damages in 1993 of $1.67 million, which equals $36.0 million; $11.8 million for residents and $24.2 million for nonresidents.

Annual total use damages are calculated as 35 percent of the annual use plus nonuse damages for the aquatic and riparian habitat resource group as estimated in the CV study ($3.84 million); total annual aquatic use damages equal $1.34 million. Annual nonuse damages are calculated as 65 percent of the total annual value, which equals $2.50 million.

We take the difference between the CV study annual use damages for aquatic and riparian habitat and the recreation study annual damages ($1.34 million - $0.55 million = $0.80 million) to compute the annual damages for all other use values. The present value of

Table 3-1
Past Damages 1981-1993 with Complete Cleanup
(millions of $ 1993, present value in 1994)†

Resource Group	Population Group	Value Category	Damages
Aquatic resources and riparian habitat	Residents	Recreation use	$11.8*
		Other use and nonuse	$53.2
	Nonresidents	Recreation use	$24.2*
		Other use and nonuse	Not quantified
	Total	All quantified	$89.2
Groundwater	Residents	Use and nonuse	$61.2**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$61.2
Upland soils, vegetation, wildlife, and wildlife habitat	Residents	Use and nonuse	$56.9**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$56.9
Total Measured	Resident	Use and nonuse	$183.1
	Nonresidents	Use and nonuse	$24.2
	Total	All quantified	$207.3

* Derived from the recreation valuation study (Morey et al., 1995).
** Derived from the contingent valuation study (Schulze et al., 1995).
*** Derived from the difference of use values in the recreation study and total values in the contingent valuation study.
† Past nonuse damages calculated in this table are based on the expectation that complete cleanup will occur between 1994 and 2014.

past damages associated with other uses is also calculated by multiplying the annual value of $0.80 million by the past use multiplier, 21.55.

Nonuse damages are lower for higher levels of cleanup because cleanup causes some bequest and existence values not to be lost. Under the assumption of complete cleanup in 20 years, the annual nonuse value of $2.50 million is translated into the present value of past damages by multiplying it by 14.42 (see Appendix Section A.1, Calculation 5b), which equals $36.0 million. Alternatively, the multiplier is 16.35, and past nonuse damages are $40.8 million assuming partial cleanup. Under the assumption of no cleanup, the multiplier is

Table 3-2
Past Damages 1981-1993 with Partial Cleanup
(millions of $ 1993, present value in 1994)†

Resource Group	Population Group	Value Category	Damages
Aquatic resources and riparian habitat	Residents	Recreation use	$11.8*
		Other use and nonuse	$58.0***
	Nonresidents	Recreation use	$24.2*
		Other use and nonuse	Not quantified
	Total	All quantified	$94.0
Groundwater	Residents	Use and nonuse	$65.7**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$65.7
Upland soils, vegetation, wildlife, and wildlife habitat	Residents	Use and nonuse	$61.1**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$61.1
Total Measured	Resident	Use and nonuse	$196.6
	Nonresidents	Use and nonuse	$24.2
	Total	All quantified	$220.8

* Derived from the recreation valuation study (Morey et al., 1995).
** Derived from the contingent valuation study (Schulze et al., 1995).
*** Derived from the difference of use values in the recreation study and total values in the contingent valuation study.
† Past nonuse damages calculated in this table are based on the expectation that partial cleanup will occur between 1994 and 2014.

21.55, and past nonuse damages for the aquatics resource group are $53.8 million (see Appendix A).

We also use the CV results to compute past damage estimates for groundwater resources and for upland soils, vegetation, wildlife, and wildlife habitat. The annual average use value for each resource is multiplied by 21.55 (Section A.1, Calculation 4), and the annual nonuse value for each resource group is multiplied by 14.42 assuming complete cleanup, 16.35 assuming partial cleanup, or 21.55 assuming no cleanup (Section A.1, Calculation 5).

Table 3-3
Past Damages 1981-1993 with No Additional Cleanup
(millions of $ 1993, present value in 1994)†

Resource Group	Population Group	Value Category	Damages
Aquatic resources and riparian habitat	Residents	Recreation use	$11.8*
		Other use and nonuse	$71.0***
	Nonresidents	Recreation use	$24.2
		Other use and nonuse	Not quantified
	Total	All quantified	$107.0
Groundwater	Residents	Use and nonuse	$77.9**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$77.9
Upland soils, vegetation, wildlife, and wildlife habitat	Residents	Use and nonuse	$72.5**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$72.5
Total Measured	Resident	Use and nonuse	$233.2
	Nonresidents	Use and nonuse	$24.2
	Total	All quantified	$257.4

* Derived from the recreation valuation study (Morey et al., 1995).
** Derived from the contingent valuation study (Schulze et al., 1995).
*** Derived from the difference of use values in the recreation study and total values in the contingent valuation study.
† Past nonuse damages calculated in this table are based on the expectation that no additional cleanup will occur.

In total, past damages for 1981 through 1993 are estimated to be $207.3 million assuming complete cleanup in 20 years, $220.8 million assuming partial cleanup in 20 years, and $257.4 million assuming no cleanup.

Missing from the estimate of past damages are all nonresident use and nonuse damages, with the exception of aquatic-based recreation use values for nonresidents.

3.2 INTERIM DAMAGES WHILE COMPLETE CLEANUP IS UNDERTAKEN

Interim damages while complete cleanup is undertaken (Area E in Figure 2-1) are computed in an analogous manner as for past damages. Annualized 1993 use damages are multiplied by a factor of 6.91 to convert them to interim damages (Section A.1, Calculation 2), and annual nonuse damages are multiplied by 2.63 (Section A.1, Calculation 7). Specifically:

- The recreation study damage estimates are used to compute aquatic resource and riparian habitat recreation use damages for residents and nonresidents.

- For aquatic resources, the difference between the annual use value in the CV study and in the recreation study ($0.80 million) is assigned to other use damages, and the nonuse damages are based on the remainder of the total annual use value in the CV study ($2.50 million).

- The CV study results are used to compute use and nonuse values for Montana residents for groundwater resources and for upland soils, vegetation, wildlife, and wildlife habitat.

Interim damages are summarized in Table 3-4 for a 20-year complete cleanup. In this event there are no residual damages. Total measured damages equal $52.4 million.

These estimates are conservative because of certain omissions including any and all nonuse damages to nonresidents, and the omission of nonresident use damages for groundwater and for soils, vegetation, wildlife, and wildlife habitat resources. Further, to the degree that the CV and recreation results are biased downward, measured damages will also be biased downward.

3.3 INTERIM AND RESIDUAL DAMAGES WITH PARTIAL CLEANUP

If partial cleanup is undertaken, both interim and residual damages occur. These damages are computed using the same approach as above. Annualized 1993 use damages are multiplied by a factor of 9.17 (Section A.1, Calculation 3) to compute the present value of interim plus residual damages (Areas C + D + E). Annual nonuse values are multiplied by a factor of 6.05 (Section A.1, Calculation 8), reflecting that a share of the injuries continue forever and a share of the injuries are cleaned up over a 20-year period. These damages are summarized in Table 3-5. Total measured damages are $87.6 million. These damages are over 67 percent larger than for interim damages with complete cleanup, which results from the increased level of interim damages plus residual damages that continue indefinitely.

These estimates are conservative because of certain omissions including any and all nonuse values held by nonresidents, and the omission of nonresident use damages for groundwater

Table 3-4
Interim Damages if Complete Cleanup Is Achieved in 20 Years
(millions of $ 1993, present value in 1994)

Resource Group	Population Group	Value Category	Damages
Aquatics resources and riparian habitat	Residents	Recreation use	$3.8*
		Other use and nonuse	$12.1***
	Nonresidents	Recreation use	$7.8*
		Other use and nonuse	Not quantified
	Total	All quantified	$23.6
Groundwater	Residents	Use and nonuse	$14.9**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$14.9
Upland soils, vegetation, wildlife, and wildlife habitat	Residents	Use and nonuse	$13.9**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$13.9
Total Measured	Resident	Use and nonuse	$44.6
	Nonresidents	Use and nonuse	$7.8
	Total	All quantified	$52.4

* Derived from the recreation valuation study (Morey et al., 1995).
** Derived from the contingent valuation study (Schulze et al., 1995).
*** Derived from the difference of use values in the recreation study and total values in the contingent valuation study.

and for upland soils, vegetation, wildlife, and wildlife habitat resources. Further, to the degree that the recreation and CV results are biased downward, measured damages will also be biased downward.

3.4 RESIDUAL DAMAGES IF NO ADDITIONAL CLEANUP IS UNDERTAKEN

Residual damages if no additional cleanup is undertaken are computed using the same approach as above. Annualized 1993 damages are multiplied by a factor of 15.29 to convert them into the present value of residual damages (Areas A + B + C + D + E; see Section A.1). Measured damages are listed in Table 3-6 and are $182.6 million. These damages are slightly more than twice the interim plus residual damages for partial cleanup. This is because the

Table 3-5
Interim plus Residual Damages if Partial Cleanup Is Achieved in 20 Years
(millions of $ 1993, present value in 1994)

Resource Group	Population Group	Value Category	Damages
Aquatic resources and riparian habitat	Residents	Recreation use	$5.0*
		Other use and nonuse	$22.4**
	Nonresidents	Recreation use	$10.3
		Other use and nonuse	Not quantified
	Total	All quantified	$37.7
Groundwater	Residents	Use and nonuse	$25.8**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$25.8
Upland soils, vegetation, wildlife, and wildlife habitat	Residents	Use and nonuse	$24.0**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$24.0
Total Measured	Resident	Use and nonuse	$77.3
	Nonresidents	Use and nonuse	$10.3
	Total	All quantified	$87.6

* Derived from the recreation valuation study (Morey et al., 1995).
** Derived from the contingent valuation study (Schulze et al., 1995).
*** Derived from the difference of use values in the recreation study and total values in the contingent valuation study.

largest interim damages occur in the near future and are discounted less heavily than are the unremediated damages (Areas A + B in Figure 2-1). If a discount rate of 3 percent, rather than 7 percent, were used to determine the present value of residual damages with no additional cleanup, such damages would amount to over $410 million.

These estimates are conservative because of certain omissions including any and all nonuse values held by nonresidents, and the omission of nonresident use damages for groundwater and for upland soils, vegetation, wildlife, and wildlife habitat resources. Further, to the degree that the CV and recreation results are biased downward, measured damages will also be biased downward.

Table 3-6
Residual Damages if No Additional Cleanup Is Undertaken
(millions of $ 1993, present value in 1994)

Resource Group	Resident Group	Value Category	Damages
Aquatic resources and riparian habitat	Residents	Recreation use	$8.3*
		Other use and nonuse	$50.4***
	Nonresidents	Recreation use	$17.2
		Other use and nonuse	Not quantified
	Total	All quantified	$75.9
Groundwater	Residents	Use and nonuse	$55.3**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$55.3
Upland soils, vegetation, wildlife, and wildlife habitat	Residents	Use and nonuse	$51.4**
	Nonresidents	Use and nonuse	Not quantified
	Total	All quantified	$51.4
Total Measured	Resident	Use and nonuse	$165.4
	Nonresidents	Use and nonuse	$17.2
	Total	All quantified	$182.6

* Derived from the recreation valuation study (Morey et al., 1995).
** Derived from the contingent valuation study (Schulze et al., 1995).
*** Derived from the difference of use values in the recreation study and total values in the contingent valuation study.

3.5 DAMAGE DETERMINATION FOR DIFFERENT TIME PERIODS OF PAST DAMAGES AND FUTURE CLEANUP

Three important assumptions used in these calculations are that (1) damages will be paid in 1994 and additional cleanup activities will start in 1994; (2) past damages are only computed back to 1981; and (3) additional restoration will linearly reduce damages over a 20-year time horizon. If past damages go unpaid until 1996, then two years of interest are added. For past damages from 1981 through 1993, this adds $30 million in additional interest at the OMB real rate of 7 percent. As more years are added to the past damages, damages increase at an increasing rate. For example, adding another 10 years to past damages (back to 1971) increases past damages by more than double. If additional cleanup programs are not initiated

for two additional years, then two additional years of past damages are added, and the present value of interim and residual damages increases as well.

The rate of cleanup affects the calculation of interim and residual damages. If cleanup reduces injuries at a slower rate, interim and residual damages will increase, and vice versa. For example, compared to a complete cleanup effort that takes 20 years, the present value of interim damages for a complete cleanup in 15 years is about 18 percent less, and the present value of interim damages for a complete cleanup in 25 years is about 15 percent greater (see Table A-2).[3] For partial cleanup, increasing or decreasing the rate of cleanup by five years changes interim and residual damages by approximately ten percent.

[3] These factors are based on use value damage multipliers (see Appendix A). The factors for nonuse damages would be comparable.

CHAPTER 4
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APPENDIX A
DETAILED CALCULATIONS

A.1 CALCULATION OF DAMAGE MULTIPLIERS

The present value (in 1994) of the damages represented by Areas A through E in Figure 2-1 is computed as a multiple of the annual damages if no remediation occurs, $D; that is, multipliers convert the annual unremediated damages into the present values of the streams of damages represented by the different areas in Figure 2-1. Calculations are presented for cleanup activities over a 20-year period using a 7 percent discount rate. The impacts of alternative time periods until cleanup activities end and alternative discount rates are presented. These damage multipliers differ for use and nonuse values as presented below.

The damage calculations are based on injuries and populations of Montana residents and nonresident recreators as of 1993. In the past, damages may have been slightly smaller because the population was slightly smaller. Similarly, adjusting interim and residual damages upward for population growth would increase future damages slightly. Because the change in population through time in Montana is small, we do not make any adjustments for past or future population changes. The net effect on estimated damages is very small.

Use Damages

Use damage multipliers are summarized below for a 20-year cleanup using a 7 percent discount rate. Detailed multipliers for Areas A through E in Figure 2-1 for alternative cleanup durations and alternative discount rates are reported in Tables A-1 and A-2.

1. *Interim and residual use damages if no additional cleanup is undertaken (Areas A + B + C + D + E)* = $\$D_U \times 15.286$. This is the present value of the annual damages in perpetuity and is computed as $\$D_U \times (1 + (1/0.07))$, which consists of two parts: $\$D_U$, the current annual use damages; and $(1 + (1/0.07))$, the factor to convert annual damages into the present value of the perpetual stream of constant future damages.

2. *Interim use damages if complete cleanup is undertaken in 20 years (Area E)* = $\$D_U \times 6.905$. This is the present value of the stream of decreasing annual damages between 1994 and the year that cleanup is completed. It is calculated as:

Table A-1
Use Value Damage Multipliers: Figure 2-1 Areas

Years to Complete Cleanup	Discount Rate	Areas (Figure 2-1)				
		A	B	C	D	E
15 (2009)	3%	4.156	16.087	1.537	5.950	6.603
	7%	2.966	4.044	1.097	1.496	5.683
	10%	2.351	1.922	0.870	0.711	5.146
20 (2014)	3%	5.047	13.877	1.867	5.133	8.411
	7%	**3.234**	**2.884**	**1.196**	**1.067**	**6.905**
	10%	2.395	1.194	0.886	0.441	6.083
25 (2019)	3%	5.749	11.970	2.126	4.427	10.061
	7%	3.328	2.056	1.231	0.760	7.911
	10%	2.320	0.741	0.858	0.274	6.806

Bold line is the base case used for damage calculations.
Past damage multipliers for 1981 through 1993 are: 3% - 16.086; 7% - 21.550; 10% - 26.975.

Table A-2
Use Value Damage Multipliers: Interim and Residual Damages

Years to Complete Cleanup	Discount Rate	Damage Scenario		
		Complete Cleanup (Area E)	Partial Cleanup (Area E + C + D)	No Additional Cleanup (Area A + B + C + D + E)
15 (2009)	3%	6.603	14.090	34.333
	7%	5.683	8.276	15.286
	10%	5.146	6.727	11.000
20 (2014)	3%	8.411	15.411	34.333
	7%	**6.905**	**9.168**	**15.286**
	10%	6.083	7.410	11.000
25 (2019)	3%	10.061	16.614	34.333
	7%	7.911	9.902	15.286
	10%	6.806	7.938	11.000

Bold line is the base case used for damage calculations.

$$\textit{Present Value of Area E} = \$D_U \times \sum_{i=1994}^{2013} \left[\frac{(2014 - i)}{20} - 0.025 \right] \times \left[\frac{1}{(1 + 0.07)^{(i - 1994)}} \right]$$

(A-1)

The term $\frac{2014 - i}{20}$ is the proportion of annual damages in year i, assuming cleanup causes damages to decline linearly from $\$D_U$ to \$0 over 20 years. The subtraction of 0.025 is a correction to compute the mid-year damages for each year. The term $\frac{1}{(1+0.07)^{(i-1994)}}$ discounts the damages in each year to 1994. This equation can be applied to other cleanup durations by adjusting the 2014 date, the number of years for cleanup, and the 0.025 correction, and to different discount rates by replacing 0.07 by the alternative discount rate.

3. *Interim plus residual use damages if partial cleanup is undertaken (Areas C + D + E)* = $\$D_U \times 9.168$. The multiplier to compute the present value of Area E is 6.905, as derived in 2 above. The multiplier to compute the present value of Areas B + D equals 3.950 and is computed as the present value of perpetual damages (15.286, as derived in 1 above) minus full damages for 20 years, or the present value of Areas A + C + E, which equals $1 + [(1 - (1 + 0.07)^{-19}] / 0.07 = 11.336$. The multiplier for Area D equals 27 percent times the multiplier for Areas B + D (3.950) and equals 1.067. The multiplier to compute the present value of Areas A + C equals the multiplier for Areas A + C + E minus the multiplier for Area E, or 4.431 (11.336 - 6.905). The multiplier for Area C equals 27 percent times the multiplier for Areas A + C (4.431) and equals 1.196. The adjustment factor of 27 percent (100 percent - 73 percent) is based on the CV result that the value of partial cleanup (Areas A + B) is 73 percent of the value of complete cleanup (Areas A + B + C + D). Thus, the multiplier to compute the present value of interim plus residual use damages if partial cleanup is undertaken = 1.196 (Area C) + 1.067 (Area D) + 6.905 (Area E) = 9.168 (Areas C + D + E).

4. *Past Use Damages (Area Z)* = $\$D \times 21.550$ for the period 1981 through 1993 and includes past damages and interest on past damages computed as:

$$Z_{use} = \sum_{i=1981}^{1993} \$D_U \times [(1.07)^{(1994-i)}] \qquad \text{(A-2)}$$

$$= \$D_U \times \{[(1.07)^{(1994-1980)} - 1] / 0.07 - 1\}$$

Using a discount rate of 3 percent the past use damage multiplier is 16.09, and using a discount rate of 10 percent the past use damage multiplier is 26.97.

Nonuse Damages

Nonuse damage multipliers are developed recognizing that additional cleanup may reduce current nonuse damages (Section 2.1.1).

5. *Past nonuse damages* depend, in part, on whether individuals expect injuries to be remediated at some point in the future or not.

   a. If individuals in the past did not expect cleanup in the near term (1994 to 2014), then nonuse damages are computed as if injury is expected to continue into perpetuity (Equation A-2), and past nonuse damages are $\$D_{NU} \times 21.550$, where $\$D_{NU}$ is the nonuse portion of annual damages if there is no future cleanup.

   b. If individuals in the past expected complete cleanup to start in 1994, and be completed in 2014, then past nonuse damages are reduced from case (a) because not all current bequest and existence values are lost. If, in the past, complete cleanup was anticipated in the period 1994 to 2014, past damages are $\$D_{NU} \times 14.423$ and are calculated as:

$$Z_{NU} = \$D_{NU} \times \sum_{i=1981}^{1993} \left[\frac{(X_i + Y_i)}{1 + \left[\frac{1}{0.07} \right]} \right] \times \left[1.07^{(1994-i)} \right] \qquad \text{(A-3)}$$

where:

$$X_i = 1 + [1 - 1.07^{-(1993-i)}] / 0.07$$

$$Y_i = 6.905 / (1.07)^{(1994-i)}$$

The first bracketed term, the ratio $(X_i + Y_i)/[1 + (1/0.07)]$, adjusts annual nonuse damages with no expectation of cleanup, SD_{NU}, downward to account for the expectation of complete cleanup between 1994 and 2014. X_i is the present value multiplier, in past year i, of full use damages between year i and 1993. Y_i is the present value multiplier, in year i, of the interim use damages (Area E). The sum, $X_i + Y_i$, when multiplied by SD_{NU}, is the present value in year i of expected future use damages with complete cleanup. The denominator, $1 + (1/0.07)$, when multiplied by SD_U, is the present value of expected future use damages with no cleanup (Calculation 1). Thus, the ratio $(X_i + Y_i)/([1 + (1/0.07)]$ is the proportion of the present value in year i of future use damages with no cleanup that will still be incurred with the expectation of future complete cleanup. The ratio is less than one, greater than zero, and approaches zero the closer one gets to 2013. It is used to reduce nonuse damages in year i with no expectation of cleanup by the same factor that the present value of future use damages is reduced by complete cleanup between 1994 and 2014. The second bracketed term in Equation A-3 converts past damages to 1994 present value.

c. If individuals in the past expected partial cleanup to start in 1994, and be completed in 2014, then past nonuse damages are reduced from case (a) because not all current bequest and existence values are lost. However, past nonuse damages are increased from case (b) because with only partial cleanup some injuries and nonuse damages occur in perpetuity. Based on the CV results, we estimate that with partial cleanup 27 percent of injuries and damages continue in perpetuity and have a present value of 0.27 × 21.550 (the present value multiplier if all damages continue in perpetuity) = 5.819. The remaining 73 percent of injuries are remediated over 20 years, so we use 73 percent of the 14.423 present value multiplier when all nonuse damages are remediated over 20 years (0.73 × 14.423 = 10.529). The sum of these two factors equals 16.347.

6. *Interim and residual nonuse damages if no additional cleanup is undertaken (Areas A + B + C + D + E)* = $\$D_{NU} \times 15.286$. This is computed in the same manner as calculation 1 for use values.

7. *Interim nonuse damages if complete cleanup is undertaken (Area E)* = $\$D \times 2.630$. This value is computed, in each year, as $\$D_{NU}$ times the present value of the remaining portion of Area E divided by the present value of perpetual damages as explained below. Damages in each year are then discounted back to 1994 as presented below.

$$E_{NU} = \$D_{NU} \times \sum_{i=1994}^{2013} \left[\frac{E_{(2014-i)} \times (2014-i)/20}{1 + (1 / 0.07)} \right] \times \left[\frac{1}{(1.07)^{(i-1994)}} \right] \qquad \text{(A-4)}$$

The first bracketed term of Equation A-4 adjusts annual nonuse damages if injuries are expected to continue into perpetuity, $\$D_{NU}$, downward to reflect reduced damages through time. $E_{(2014-i)}$ is the present value multiplier in year *i* of Area E assuming complete cleanup in 2014 (using Equation A-1). (2014 - *i*) / 20 is the proportion of annual use damages in year i, assuming cleanup causes use damages to decline linearly from $\$D_U$ to \$0 over 20 years. The numerator is thus the present value multiplier in year *i* associated with the remaining use damages. The denominator, 1 + (1/0.07), is the present value of expected future use damages with no cleanup. Thus, the first bracketed term is the proportion of the present value in year *i* of future use damages with no cleanup that will still be incurred with the expectation of future complete cleanup. This ratio differs from the ratio in Equation A-3 only in that A-3 includes a component for past damages. The ratio is used to reduce nonuse damages in year *i* by the same factor that the present value of future use damages is reduced by complete cleanup between 1994 and 2014. Finally, the second bracketed term in Equation A-4 discounts the damages in year *i* to the present value in 1994.

Based on this formulation, interim nonuse damages decrease rapidly as cleanup progresses. Let $\$D_{NU}$ = \$1 be the annual nonuse damages if no additional cleanup is undertaken. Using this calculation, an assumed complete cleanup in 20 years, and a 7 percent discount rate, example values are:

Year *i*	Years Until Complete Cleanup	Interim Nonuse Damages in Year *i*	1994 PV of Damages in this Year
1994	20	\$0.452	\$0.452
1999	15	\$0.279	\$0.199
2004	10	\$0.137	\$0.069
2009	5	\$0.038	\$0.014
2012	2	\$0.008	\$0.002
2013	1	\$0.002	\$0.000

8. *Interim plus residual nonuse damages if partial cleanup is undertaken (Area E + C + D)* = $\$D_{NU} \times 6.047$. Based on the CV results, we estimate that, with partial cleanup, 27 percent of injuries and damages continue in perpetuity and have a present value multiplier of 0.27 × 15.286 (the present value multiplier if all damages continue in

perpetuity) = 4.127. The remaining 73 percent of injuries are remediated over 20 years, so we use 73 percent of the 2.630 present value multiplier (Area E) when all damages are remediated over 20 years (0.73 × 2.630 = 1.92). The sum of these two factors equals 6.047.

A.2 CALCULATION OF ANNUALIZED DAMAGES FOR MONTANA RESIDENTS FROM THE CV STUDY

Annual Total Values

The CV study provides WTP estimates of the total of use plus nonuse values for complete cleanup and partial cleanup of the sites based on a payment occurring over ten years. Based upon a 7 percent discount rate, the present value of the complete cleanup is $120.2 million. The cleanup time period matters in a CV study. The value one holds to clean up a site decreases the longer the cleanup takes. For example, a cleanup of a river taking ten years will have a lower value than the same cleanup taking one year because more years of use, bequest, and existence values would be lost with a ten-year cleanup than would be lost with a one-year cleanup. The WTP study estimates annual WTP over ten years to obtain complete cleanup and partial cleanup of the Clark Fork NPL sites.

The implicit cleanup time frame is generally assumed by respondents to match or exceed the payment period in the CV survey (ten years), because funded activities may occur over ten years, but respondents recognize that the results may take longer to attain. We compute the equivalent annual damages as follows for three alternative assumptions about site cleanup:

1. Assuming the CV values are for a gradual cleanup over ten years, the complete cleanup values of $120.2 million correspond to Areas A + B + C + D in Figure 2-1 for a ten-year cleanup. Using Calculations 1 and 2 in Section A.1, but for a ten-year period, the present value factor is 11.112 (15.286 - 4.174). Therefore, the annual value of current damages is $120.2/11.112, or $10.8 million.

2. Assuming the CV values are for a sudden cleanup (the resources are suddenly available) after ten years, then the $120.2 complete cleanup value would be interpreted as corresponding to Areas B + D in Figure 2-1 for a ten-year period. The 1993 annual value of damages is thus $120.2/7.770, or $15.5 million. This value is about 44 percent larger than when assuming a gradual cleanup over ten years.

3. Assuming the CV values are for a gradual cleanup over 20 years, the $120.2 million corresponds to Areas A + B + C + D in Figure 2-1. Using Calculations 1 and 2 in Section A.1, the annual value is $120.2/8.380 = $14.3 million, or 33 percent larger than assuming a gradual cleanup over ten years.

In the analysis we use Assumption 1, which is the most conservative interpretation of the CV results. Next, we compute the annual current damages for each resource group using the same 11.112 factor as in Assumption 1. These values are reported in Table A-3.

Table A-3
Calculation of Annual Damages to Montana Residents from the CV Survey
(millions of $ 1993, present value in 1994)

	Variable	Aquatic Resources and Riparian Habitat	Groundwater Resources	Upland Soils, Vegetation, Wildlife, and Wildlife Habitat
1.	Adjusted present value of complete cleanup (Table 2-3)	$42.7	$40.2	$37.4
2.	Annual value of complete cleanup (line 1/11.112)	$3.84	$3.62	$3.36
3.	Annual use values (assume 35 percent; recreation estimate based on Morey et al., 1995; see Table 2-2)	$0.55 (recreation) $0.80 (other use)	$1.27	$1.18
4.	Annual nonuse values (assume 65 percent)	$2.50	$2.35	$2.19

Splits between Use and Nonuse Values

Finally, where required, we allocate the CV estimates to use and nonuse values to apply the additional correction factor to nonuse values to determine the present value of past and interim damages. It is important to recall that without the nonuse correction factor that accounts for future remediation, a split between use and nonuse values is not required. Further, given uncertainty about the amount and timing of cleanup, it may be appropriate to include nonuse damages without correcting for future cleanup.

The split of total CV values between use and nonuse motives was not specifically estimated in the CV survey, although the results reported in Table 4-7 of the CV report (Schulze et al., 1995) suggest that, across all resource groups, nonuse motives are more important than use value motives. For recreation, we use the use value estimates from the recreation study

because that study provides a direct estimate of recreation use values. For all three resource groups, based on similar CV studies, we assume that 35 percent of the CV estimate is for use, and the remainder is for nonuse. The resulting annual use and nonuse values by resource group are reported in Table A-3.

It is important to note that the split of total values between use and nonuse motives has no impact on residual damage estimates after partial cleanup. Further, the split of total values between use and nonuse motives has a small impact on past damages. For example, for past damages, the multiplication factor for annual use values is 21.55 (Section A.1, Calculation 4), and for annual nonuse values is 14.42 assuming complete cleanup (Section A.1, Calculation 5b). If the split of total values to use motives were 20 percent higher or lower (55 percent or 15 percent), total past use plus nonuse damages would change by less than 7 percent.

The split of total damages between use and nonuse damages may affect interim damages more significantly. For interim damages, the annual use value multiplier is 6.91 (Section A.1, Calculation 2), and the annual nonuse multiplier is 2.63 (Section A.1, Calculation 7). If the split of total values to use motives were 20 percent higher or lower (55 percent or 15 percent), total use plus nonuse interim damages for complete cleanup would change by approximately 18 percent. Overall, assigning the CV damages to use and nonuse motives has a relatively small impact on the analysis as compared to other conservative assumptions made in the damage determination.

APPENDIX B
RESPONSE TO COMMENTS

B.1 INTRODUCTION

In his expert report of June 13, 1995, Dr. Hausman presents several critiques of the State's damage determination report of January, 1995. This revised damage determination report (October, 1995) changes only the computations of damages to reflect updates in the recreational analysis and other minor edits. Dr. Hausman's comments on the January report are not substantially affected by the computational revisions in this revised report.

In this appendix we address Dr. Hausman's comments in order. His asserted percent corrections in Table 6 are not appropriate, are not documented (in his report or in his materials provided under discovery), and in many cases cannot be replicated.

B.2 RESPONSIBILITY BIAS CORRECTION

Dr. Hausman asserts that the damages should not include the "responsibility bias correction" computed in the State's contingent valuation (CV) report, which he computes would reduce damages by 23.5 to 26.2 percent (page 55). As discussed in the State's rebuttal to Dr. Hausman's CV comments (Schulze et al., 1995, Section 7.3), his suggested revision is not well documented and has little merit. No change is made reflecting this comment.

B.3 COMPUTING ANNUALIZED DAMAGES WITH THE CV STUDY RESULTS

When using the CV report results, the State determines damages through two major steps. First, the average willingness to pay (WTP) per year for ten years to achieve a complete cleanup is discounted to a present value and is then converted to an annualized damage amount corresponding to the current unremediated level of injuries. Second, damages through time are computed as the annualized damages adjusted for the remediation assumed to occur through time, and the stream of annual damages are discounted to a present value. In this section, we discuss Dr. Hausman's interest rate comments pertaining to the first step in this process. In Section B.5, we discuss Dr. Hausman's comments pertaining to using interest rates in the second step of this process.

Dr. Hausman makes a number of comments about the computation of the present value of ten years of annual payments estimated in the State's CV study (pages 55-57). He first suggests

that only Version 1 WTP results should be used to compute WTP for complete cleanup ($44), which he asserts would reduce computed WTP by 9.4 to 10.6 percent (pages 55-56). The State used the average of the WTP values from survey Versions 1 and 2 ($49), because this more fully reflects the information received from Montana residents. Dr. Hausman claims that only CV Version 1 results should be used because of "sequence bias." As discussed in the State's rebuttal to Dr. Hausman's CV comments (Schulze et al. 1995, Section 4), he has assumed sequence bias without foundation.

Second, Dr. Hausman raises a concern about the 7 percent discount rate used to discount the CV study annual WTP amounts to a present value (page 56-57). Throughout the damage determination report, the State used a 7 percent real discount rate as specified in the OMB circular. Had a lower real rate been used, such as around 3 percent as suggested by ARCO's experts (Hausman pages 58-60, and Desvousges and Waters Volume III pages D21-23), the discounted present value of the CV study annual WTP amounts, and the estimated damages for the case, would increase (see Table A-2 in the Compensable Damage Determination report).

A third and related issue raised by Dr. Hausman is whether to treat the WTP responses as nominal (assuming respondents ignore future inflation when computing their annual WTP) or as real (assuming respondents factor in inflation when computing their annual WTP). We find no evidence in the respondent comments to indicate that respondents undertake the mental exercise to predict and factor in inflation, possibly because inflation rates have been low in recent years. Therefore, the State treated the annual WTP as real (in $1993 dollars when the responses were given). Dr. Hausman suggests the WTP responses should be treated as nominal and a higher nominal interest rate used. However, if we treat the WTP responses as nominal, as suggested by Dr. Hausman; use a real interest rate, such as 3 percent as suggested by Dr. Hausman and by Drs. Desvousges and Waters; and add 3-4 percent for expected inflation to escalate real interest rates to nominal interest rates, as suggested by Hausman and by Desvousges and Waters; we again would be discounting at about 7 percent. Therefore, if we completely follow ARCO's experts' recommendations in a consistent manner rather than present the recommendations piecemeal, the estimated damages are effectively the same as presented by the State.

B.4 TREATMENT OF NONUSE LOSSES

Dr. Hausman raises three issues with the calculations of nonuse damages (pages 57-58, and pages 60-61). The first issue is a supposed inconsistent computation of nonuse values, which he asserts will reduce damages by 12.5 to 13.7 percent (page 57). Dr. Hausman's suggested revision is incorrect. A detailed discussion of this issue is presented in Section B.4.1.

The second issue concerns the split of total WTP between direct use and nonuse motives, which he asserts is speculative (Footnote 35 on page 57). Rather, as was provided in response

to a deposition request, there is literature and data to support the procedure used by the State, as summarized in Section B.4.2. Moreover, as noted in the summary report, modest to large changes to this assumption have only a small impact on the computed damages.

The third issue concerns the basis for reducing nonuse values when there will be cleanup in the future. He asserts the state has no basis for choosing the approach used, and he asserts damages should be "reduced by 16.9 to 50.6 percent depending on the cleanup scenario" (page 61). As demonstrated in Section B.4.3, the state has an appropriate basis for its approach. Dr. Hausman's instead makes an extreme assumption that is not reliable.

B.4.1 Computation of Annualized Nonuse Damages When There is No Future Cleanup

Current and ongoing nonuse damages are a function of the level and timing of injuries in the future. The State computes past, current and future nonuse damages reflecting the expected future level and timing of cleanup. Dr. Hausman asserts that the State's computations are in error by not correctly accounting for future cleanup (page 57-58). This comment is the apparent result of a misinterpretation of the State's analysis. This revised summary report includes minor editorial modifications to clarify this confusion. The computation process, and Dr. Hausman's error, are briefly described below.

The State's process for computing the present value of nonuse damages through time involves three steps:

1. An annualized measure of nonuse damages in 1994, *if no cleanup is undertaken*, SD_{NU}, is computed. SD_{NU} is computed by (a) taking the present value of the stream of annual payments from the CV study ($49 per year for 10 years), (b) separating this into a use and nonuse component (See Section B.4.2), and then (c) annualizing the use and nonuse components. The present value of the CV study WTP corresponds to areas A+B+C+D in Figure 1. The annualization factor equals 15.286-4.174 = 11.112.[1] 15.286 equals the annualization factor for the Areas A+B+C+D+E *assuming no future cleanup* (Calculation 6, which equals Calculation 1, in Appendix A). 4.174 equals the annualization factor for Area E computed *assuming no future cleanup* (Calculation 2 for a 10 year period).

2. If site cleanup occurs in the future, nonuse damages in each interim years are reduced reflecting reduced injuries in that year and expected reduced injuries in future years. The state computes annual nonuse damages in each year as SD_{NU}

[1] The 11.112 factor in the January 1995 report was inadvertently reported as 11.528. Correcting this typographic error increases the nonuse multiplier approximately 3.7 percent and increases total damages by less than 2 percent.

(the annual nonuse damages if no cleanup occurs) times the ratio of (a) the present value of use damages in the future with expected cleanup divided by (b) the present value of use damages in the future if no cleanup occurs.

3. The stream of future annual nonuse damages, computed in Step 2, are discounted to a present value as of January 1994.

Dr. Hausman notes that ongoing nonuse damages have to decrease if there is future cleanup. This is accounted for in Step 2. His error arises in that he also suggests that future cleanup should reduce the computation of $\$D_{NU}$ in the Step 1 calculation. This is incorrect and would result in double adjusting the nonuse computations for future cleanup. Further, it is conceptually incorrect. Given $\$D_{NU}$ is the annual nonuse damages *if there is no future cleanup*, then computing $\$D_{NU}$ based on an annualization factor for Figure 1 Areas A+B+C+D assuming no cleanup minus the annualization factor for Figure 1 Area E assuming there is future cleanup (as suggested by Dr. Hausman) is simply inconsistent because it mixes assumptions about cleanup in the computation of $\$D_{NU}$.

B.4.2 Split of Total WTP to Direct and Passive Use Motives

In this section we explain the need for the State's procedures to separate total WTP to direct use and nonuse motives, and we provide explicit literature and data to support the State's procedures.

The summary damage computations were performed separately for use and nonuse values to account for potential reductions in ongoing nonuse values where there may be future cleanup of the sites. The split of total WTP between use and nonuse value was not specifically estimated in the CV survey, although results in Table 4-7 of the CV report indicate that, across the entire sample, motives associated with nonuse are more important than are motives associated with direct use. Based on this data and the literature, the State assumed 35 percent of total WTP was associated with direct use and 65 percent of WTP was associated with nonuse. The smaller the percent assigned to use motives the smaller damages will be in the total damage calculations because nonuse damages are discounted to account for potential future cleanup at the site (Section B.4.1). However, even a substantially different use/nonuse split than 35 percent/65 percent does not substantially impact the damage computations. As noted in the State's summary report (pages A-8 and A-9), if use values were assigned either 15 percent, or 55 percent, rather than 35 percent, past damages would change by less than 5 percent and total interim use plus nonuse damages for complete cleanup would change by approximately 13 percent.

The literature (Table 5-1) and the data from the CV survey (Table B-2) support the State's procedure of assigning approximately 35% to use values. The studies in Table B-1 are for CV studies addressing natural resource protection and improvements in the western U.S. In each

Table B-1
Literature on the Split of Total WTP to Use and Nonuse Motives

Citation	Application and Respondents	Allocation to Use Motives[1]
Rowe et al. (1986)	Cleaning up Colorado NPL sites. Colorado residents	Statewide: 33 percent. By location: 30-40 percent.
McClelland et al. (1992)	Preventing and remedying groundwater contamination. Nationwide.	35 percent for own use.
Chestnut and Rowe (1990 a,b)	Protecting visibility in national parks in three regions. Residents of Arizona, California, Virginia.	Local region of respondent: 35 percent. Own use ranked importance as 4.1. Sum of scores for all motives = 24.4. Own use = 16.8 percent of all motives listed. Some motives overlap.
Walsh et al. (1982); Walsh et al. (1984)	Preserving wilderness in Colorado. Colorado residents.	65 percent for use for preserving 1.2 million acres.
Walsh et al. (1985), Sanders et al. (1990)	Preserving wild and scenic rivers in Colorado. Colorado residents.	For the three most valuable rivers: 16.1 percent to 38 percent for use.
Sutherland and Walsh (1985)	Protecting water quality at Flathead Lake in Montana. Montana residents.	28.1 percent for use (current own use and option for future own use).
Greenley et al. (1981)	Preserving water quality in the South Platte Basin. Denver and Fort Collins, Colorado residents.	34.2 percent for use (current own use and option for future own use).

[1] Percent splits as provided by respondents in the CV study. In the Chestnut and Rowe study, ranking scores of motives (on a 1 to 7 scale) also are summarized.

Table B-2
Ranking of Motives for Montana Resident's Motives for Cleaning up the Upper Clark Fork Sites
(CV Survey Question 26)

Motive	Mean Score* (Standard Error of the Mean)
For use by future generations	5.75 (0.053)
For current use by others	5.12 (0.057)
Even if no one ever uses them	4.73 (0.071)
For current use by my family and myself	4.19 (0.075)
Total of all scores	19.79

* Motives ranked from 1 = *not at all important*, to 7 = *extremely important*)

of these studies, respondents were directly asked to split their stated WTP to use and nonuse motives. In these studies, the percent of total values that respondents allocated to use motives range from 16 percent to 65 percent, with the predominance of results in the 28 percent to 38 percent range.

In the State's CV study, respondents rated their motives for cleaning up the upper Clark Fork sites (Q26). The mean scores for these ratings (from Table 4-7 of the State's CV report) are reported in Table B-2. Adding the scores together for all listed motives, the score for one's own direct use is 21 percent of the total scores. However, this understates the importance of one's own direct use because there is an overlap of two bequest motive categories listed and because these scores need not sum to a fixed total, such as is the case for the percent allocation of total WTP. This is illustrated in Table B-1 for the Chestnut and Rowe (1990 a,b) study on protecting visibility at National Parks where respondents directly assigned about 35 percent of their value to their own direct use of national parks in the region where they live. When simply using the scores on how important individual motives are (with a similar question and 1 to 7 scoring system as in question 26 in the Montana CV survey), one's own direct use has just 16.8 percent of the total score for the 6 motives listed.

B.4.3 Nonuse Adjustment When There is Cleanup in the Future

Dr. Hausman asserts that the State has no basis for choosing how to adjust nonuse values to account for future cleanup (pages 60-61). This statement is incorrect, as presented in the State's damage determination report.

In the State's CV study, respondents rated reasons for cleaning up hazardous wastes in the Upper Clark Fork basin (Table B-2). Clearly, bequest for use by others now, and bequest for use by others in the future (the first two motives in Table B-2) are the highest ranked reasons for cleaning up these sites. The State's nonuse damage computations (See Section B.4.1) are based on the discounted present value of the stream of future use damages accounting for cleanup through time. This adjustment is consistent with respondents' emphasis on bequeathing the resources for others to use now and in the future.

Existence motives (ranked third in Table B-2) is important, but of lesser importance than bequest motives. Existence motives are tied to the well-being of wildlife, ecosystem integrity, preservation of resources for future research or unknown uses, and other motives. Many of these reasons for existence values are also tied to ongoing current and future injuries just like bequest values. Therefore, there are existence damages through time associated with interim injuries, even if a resource is completely cleaned up in 20 years from now.

Dr. Hausman's assumption would be "that nonuse losses are zero when complete cleanup will occur in the future" (page 61). This assumption is inconsistent with respondents' values, is clearly the most extreme alternative that could be presented, and is not a reliable basis for computing damages.

B.5 SELECTING AN INTEREST RATES TO DISCOUNT DAMAGES THROUGH TIME

The State computes the present value of past, interim and residual future damages using the OMB specified rate of 7 percent. Dr. Hausman suggests that past damages should be reduced 10.7 percent to 14.7 percent by using a lower risk free interest rate rather than the 7 percent rate used by the State (pages 58-60). He provides only a partial presentation of how using a lower real discount rate effects the damage calculations in the case, and therefore provides a misleading presentation of the significance of this issue.

Dr. Hausman is correct that using a lower "risk free" discount rate results in a reduced present value of past damages. But, he fails to note that using a lower discount rate also results in offsetting increases in the present value of future, interim, and residual damages because:

- Future damages will be less heavily discounted. In fact, analysis by ARCO's experts (Cambridge Economics CAM000000195, and Desvousges and Waters

(the annual nonuse damages if no cleanup occurs) times the ratio of (a) the present value of use damages in the future with expected cleanup divided by (b) the present value of use damages in the future if no cleanup occurs.

3. The stream of future annual nonuse damages, computed in Step 2, are discounted to a present value as of January 1994.

Dr. Hausman notes that ongoing nonuse damages have to decrease if there is future cleanup. This is accounted for in Step 2. His error arises in that he also suggests that future cleanup should reduce the computation of $\$D_{NU}$ in the Step 1 calculation. This is incorrect and would result in double adjusting the nonuse computations for future cleanup. Further, it is conceptually incorrect. Given $\$D_{NU}$ is the annual nonuse damages *if there is no future cleanup*, then computing $\$D_{NU}$ based on an annualization factor for Figure 1 Areas A+B+C+D assuming no cleanup minus the annualization factor for Figure 1 Area E assuming there is future cleanup (as suggested by Dr. Hausman) is simply inconsistent because it mixes assumptions about cleanup in the computation of $\$D_{NU}$.

B.4.2 Split of Total WTP to Direct and Passive Use Motives

In this section we explain the need for the State's procedures to separate total WTP to direct use and nonuse motives, and we provide explicit literature and data to support the State's procedures.

The summary damage computations were performed separately for use and nonuse values to account for potential reductions in ongoing nonuse values where there may be future cleanup of the sites. The split of total WTP between use and nonuse value was not specifically estimated in the CV survey, although results in Table 4-7 of the CV report indicate that, across the entire sample, motives associated with nonuse are more important than are motives associated with direct use. Based on this data and the literature, the State assumed 35 percent of total WTP was associated with direct use and 65 percent of WTP was associated with nonuse. The smaller the percent assigned to use motives the smaller damages will be in the total damage calculations because nonuse damages are discounted to account for potential future cleanup at the site (Section B.4.1). However, even a substantially different use/nonuse split than 35 percent/65 percent does not substantially impact the damage computations. As noted in the State's summary report (pages A-8 and A-9), if use values were assigned either 15 percent, or 55 percent, rather than 35 percent, past damages would change by less than 5 percent and total interim use plus nonuse damages for complete cleanup would change by approximately 13 percent.

The literature (Table 5-1) and the data from the CV survey (Table B-2) support the State's procedure of assigning approximately 35% to use values. The studies in Table B-1 are for CV studies addressing natural resource protection and improvements in the western U.S. In each

where respondents indicated they felt the cleanup period would be about ten years corresponding to the revenue collection period, and based on prior experience with similar questions. No respondents indicated to us that they felt cleanup could be accomplished in a shorter time period, which makes sense given the geographic scope and the magnitude of the injuries at the sites.

Alternatively, Dr. Hausman suggests that "a plausible alternative assumption is that respondents thought cleanup would occur in a short period of time, say two years" (later he also suggests an alternative of five years - pages 61-62), which he suggests will reduce damages. Again, his computations are not documented. Dr. Hausman cites no basis for these speculative assumptions, which appear to be motivated only to attempt to reduce damages.

B.8 REFERENCES

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